

# **Oil Technology**

## **Program Mission**

The mission of the Oil Technology Program is to create public benefits by investing in research that the oil industry would not take on itself: long-term, high-risk research with potentially high payoffs for the public. These payoffs include a cleaner environment, more secure and stable supplies and new potential resources. The President's National Energy Policy states that 21<sup>st</sup> century technology is the key to environmental protection and new energy production, and federal research can augment industry's technology development efforts in ways that target the public interest. The activities of this program will help the industry ensure that supplies of oil are accessible to enhance our Nation's energy security, while also ensuring that the resources are developed in an environmentally sound manner.

Fossil Energy programs are being realigned to specifically support the President's climate change and energy security goals. Through the implementation of the President's Management Agenda, the Natural Gas and Oil Technology programs completed Investment Criteria Scorecards of all program elements and also completed were 19 "mini" scorecards down to the project level. The programs also completed the Program Assessment Rating Tool (PART) for all program elements. Analysis of PART showed that the program did not link annual activities and their products to long-term benefits. In addition, the program was determined to have poor results and to duplicate industry work.

The budget delineates program goals such as Enhanced Oil Recovery/CO<sub>2</sub> Injection, Domestic Resource Conservation, and Environmental Science as funding categories. This allows the program to phase out projects and activities that are neither productive nor important to the program's mission and goals. Investments will maximize the efficiency of taxpayer dollars by focusing solely on activities that require a Federal presence to attain the President's climate change and energy security goals.

For example, the President's climate change goal is addressed through ensuring that research and technology development support effective management practices of carbon and greenhouse gases to reduce their concentration in the atmosphere. This includes the use of carbon dioxide injection to revitalize domestic energy production while sequestering carbon. When appropriate, collaborations with other Federal agencies, industry, academia, and states will be used to accomplish this goal. America's energy security can be enhanced by ensuring that research and technology development support a vibrant U.S. oil and gas industry that continues to be the base for global exploration and production. This includes research that supports solid policy decision-making and technology development that allows for greater access to energy resources with no environmental impact.

## **Program Strategic Performance Goal**

Sub-programs in the Oil Technology Program support the following Program Strategic Performance Goal (PSPG):

**ER5-1:** By 2008, develop advanced technologies and employ scientifically based policy options to increase the Nation's economically recoverable resource by 15 trillion cubic feet (Tcf) for natural gas and 140 million barrels for oil and reduce future costs of exploration and production by \$10 billion. According to the USGS, EIA, and MMS, the economically recoverable oil resource base is estimated to be 120 billion barrels at \$18/bbl. and 149 billion barrels at \$30/bbl; the gas base is estimated to be 740 Tcf at \$2.00/thousand cubic feet (mcf) and 920 Tcf at \$3.50/mcf in 2002.

Three subprograms make up the Oil Technology program. The performance measures are listed in the table below. The Enhanced Oil Recovery/CO<sub>2</sub> Injection activity, performed within the Exploration and Production subprogram and the Domestic Resource Conservation activity, performed with the Reservoir Life Extension/Management sub-program, support the Department's PSPG ER5-1, and has the following goal:

- By 2008, develop and field test a suite of technologies with the potential to increase the economically recoverable resource by 140 million barrels of oil and 0.3 TCF of natural gas from existing and frontier resources and reduced costs of \$0.1 Billion.

The Environmental Science activity, performed within the Effective Environmental Protection subprogram, supports the PSPG ER5-1 and has the following goal:

- By 2008, develop and demonstrate technologies in oil and gas environmental management with potential to reduce costs of environmental protection in field operations by \$10 billion with some production increases while improving the Nation's air, water, and soil quality.

### **Performance Indicators**

The performance indicators for the Enhanced Oil Recovery/CO<sub>2</sub> Injection and Domestic Resource Conservation activities will be as follows:

- Annual estimates of economically recoverable oil resources attributable to program activities.
- Increased revenue from royalty payments and dollars saved from production lower costs.

The performance indicator for the Environmental Science activity will be as follows:

- Smaller environmental impact of production and recovery operations as a result of technologies developed.

### **Annual Performance Targets and Results**

FY 2004 annual proposed targets and associated quarterly milestones continue to be refined using OMB's guidance to better link annual outputs to long-term outcomes and to reflect the refocusing of the research into areas with a strong Federal role. Effective Environmental Protection performance targets for both the Natural Gas Technologies and Oil Technology programs are contained in the Oil Technology section of this budget listing.

## Program Benefits

Each year Fossil Energy estimates the benefits of program activities to support Government Performance and Results Act (GPRA) reporting. Methods are complex and vary by program. The Oil and Gas Programs have traditionally used two separate economic and engineering modeling systems to calculate selected economic and energy security benefits. In 2002, a two-year effort, involving external peer review, was begun to integrate these two separate modeling systems into one system for improved simulation of resource and market conditions, and consistency of technology assumptions and model outputs. Under the previous two model systems, deficiencies, such as the assumption of unlimited industry capital availability, could result in an overestimation of industry's response to DOE's R&D products. Conversely, deficiencies, such as only modeling upstream R&D activities and not calculating the synergistic benefits of oil and gas R&D efforts, could result in an underestimation of the benefits of DOE's programs.

The new model will provide the following expected benefits:

- Complimentary technology development in oil and gas research.
- Full R&D program activities can be modeled.
- Ability to calculate synergistic benefits of both programs.

As part of the effort to conform to the President's Management Agenda in a shorter-term, Fossil Energy has undertaken an integrated program benefits analysis of oil, natural gas, coal and power systems research within Fossil Energy to develop Fossil Energy-wide program benefits estimates. This analysis, using the Energy Information Administration National Energy Modeling System (NEMS) and scheduled to be completed in mid-2003, is examining all Fossil Energy research programs on a common basis with respect to modeling assumptions and should enable aggregate and comparative assessments of the benefits of Fossil Energy research programs.

FY 2002 Results	FY 2003 Updated Targets	FY 2004 Targets
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### ER5-1

Demonstrate a small-diameter, light-weight composite drill pipe for ultra-short radius drilling that will lower overall exploration/production costs. (ER5-1) (Met goal)

**Research:** Issue one solicitation for Micro-hole technologies research for enabling improved access and minimizing environmental impact.

Develop six conceptual models and techniques related to chemical flooding, reservoir and flow simulation, and reservoir characterization for enhancing oil recovery technologies.

**Research:** Award one project on Micro-hole technologies drilling research for future applications on state and Federal lands and waters, and addressing nearer-term barriers.

Develop advanced techniques for simulation and modeling of non-conventional reservoirs to improve oil recovery in existing fields.

FY 2002 Results	FY 2003 Updated Targets	FY 2004 Targets
	<p>Complete analysis of bench-scale reverse osmosis in produced water treatment equipment to increase resource recovery without impacting the environment.</p>	<p>Prepare baseline characterization of Wyoming and Montana groundwater systems and coalbed methane production.</p>
	<p>Construct greenhouse prototype for phytoremediation for coalbed methane produced water to determine feasibility of its use for agriculture.</p>	
	<p><b>Development:</b> Conduct field tests for oil field centrifuge control systems using fuzzy logic to reduce the cost of waste disposal using an environmentally-sound approach.</p>	<p><b>Development:</b> Sponsor International Petroleum Environmental Conference (IPEC) to increase availability of advanced environmental technology.</p>
	<p>Conduct improved oil recovery techniques; seismic sonic stimulation (1 project), data acquisition (2 projects), fracture model interpretation (1 project), and steamflood simulation (1 project) in existing light and heavy oil reservoirs at sites ranging from Alaska to Utah.</p>	<p>Accelerate transfer of technology to U.S. producers, especially the small independent companies through 25 regional workshops and co-sponsor the IOR Symposium.</p>
	<p>Conduct 5 bench tests in surfactant behavior, and in paraffin deposition, for enhanced oil recovery technologies.</p>	<p>Pioneer two actions to provide scientific data and analyses to enable states and other Federal agencies to make more cost-effective regulatory and policy decisions that increase oil or natural gas supplies to American consumers.</p>
	<p>Participate in 66 regional workshops for accelerated technology transfer to U.S. independent producers.</p>	

FY 2002 Results	FY 2003 Updated Targets	FY 2004 Targets
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Develop kinetics for model compounds to be used in enzymatic and biomimetic catalysts for upgrading heavy crude oils.

### Funding Profile

(dollars in thousands)

	FY 2002 Comp. Approp.	FY 2003 Request	FY 2004 Base	FY 2004 Request	FY 2004 Request vs. Base	
					\$ Change	% Change
Exploration and Production . . . .	\$33,207	\$16,400	\$16,400	\$2,000	\$-14,400	-87.8%
Reservoir Life						
Extension/Management . . . . .	12,611	9,500	9,500	5,000	-4,500	-47.4%
Effective Environmental						
Protection . . . . .	10,426	9,500	9,500	8,000	-1,500	-15.8%
Total, Oil Technology . . . . .	<u>\$56,244</u>	<u>\$35,400</u>	<u>\$35,400</u>	<u>\$15,000</u>	<u>\$-20,400</u>	<u>-57.6%</u>

### Funding by Site

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	\$Change	%Change
Argonne National Lab (East) . . . . .	\$100	\$0	\$0	\$0	0.0%
Idaho Natl. Engineering & Environmental Lab . . .	110	204	0	-204	-100.0%
Lawrence Berkeley Lab . . . . .	200	0	0	0	0.0%
Lawrence Livermore National Lab . . . . .	1,630	0	0	0	0.0%
Los Alamos National Lab	1,493	48	0	-48	-100.0%
National Energy Technology Lab . . . . .	850	1,710	900	-810	-47.4%
Oak Ridge National Laboratory . . . . .	2,377	500	0	-500	-100.0%
Sandia National Lab	1,975	0	0	0	0.0%
All Other . . . . .	47,509	32,938	14,100	-18,838	-57.2%
Total, Oil Technology . . . . .	<u>\$56,244</u>	<u>\$35,400</u>	<u>\$15,000</u>	<u>\$-20,400</u>	<u>-57.6%</u>

### Site Description

No FY 2004 funding planned for National Labs other than NETL.

The following labs received FY 2002-2003 funding in the described areas.

## **Argonne National Laboratory (East)**

The Argonne National Laboratory (ANL), located in Argonne, Illinois, is a major multi-program laboratory managed and operated for the U.S. Department of Energy (DOE) by the University of Chicago under a performance-based contract. Argonne research for the Fossil Energy Oil Technology program supports DOE strategies to support oil and gas environmental research.

## **Idaho National Engineering and Environmental Laboratory**

The Idaho National Engineering and Environmental Laboratory (INEEL), located outside of Idaho Falls, Idaho, conducts research and development in the area of Oil Technology to support microbial enhanced oil recovery (MEOR) and environmental research.

## **Lawrence Berkeley National Laboratory**

The Lawrence Berkeley National Lab (LBNL), located in Berkeley, California, conducts research and development in the area of Oil Technology to support EOR and environmental modeling.

## **Lawrence Livermore National Laboratory**

The Lawrence Livermore National Laboratory (LLNL), located in Livermore, California, conducts research and development in the area of Oil Technology to support environmental and reservoir modeling.

## **Los Alamos National Laboratory**

The Los Alamos National Laboratory (LANL), located in Los Alamos, New Mexico, conducts research and development in the area of Oil Technology to support seismic and drilling research.

## **National Energy Technology Laboratory**

The National Energy Technology Laboratory (NETL), located in Morgantown, West Virginia, Pittsburgh, Pennsylvania, and Tulsa, Oklahoma, is a multi-purpose laboratory, owned and operated by the U.S. Department of Energy. NETL conducts and implements science and technology development programs for the Department in energy and energy-related environmental systems. NETL's key functions are to shape, fund, and manage extramural (external ) RD&D projects, conduct on-site science and technology research, and support energy policy development and best business practices within the Department. Specific onsite expertise in EOR, environmental science, computational chemistry, and policy analysis supports the Oil Technology Program.

# Oak Ridge National Laboratory

The Oak Ridge National Laboratory (ORNL), located in Oak Ridge, Tennessee, conducts research and development in the area of Oil Technology to support environmental and oil processing research.

# Sandia National Laboratory

The Sandia National Laboratory (SNL), located in Albuquerque, New Mexico, conducts research and development in the area of Oil Technology to support geophysical and reservoir management research.

# All Other

The Department’s Oil Technology program, within the Fossil Energy and Development program, funds research at major performers at non-DOE locations. Examples of these performers include partnerships with industry, universities, state and local governments, and other organizations. Private sector participation is emphasized through industry cost-sharing with individual companies and consortia to ensure market relevance and to facilitate the transfer of technology to the private sector while leveraging Federal R&D investment.

## Detailed Program Justification

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
Exploration and Production .....	33,207	16,400	2,000
■ EOR/CO <sub>2</sub> Injection	0	0	1,980

This program aims to develop technologies that will overcome major market and technological barriers to increase domestic supply of oil at reasonable prices while protecting the environment. In FY 2004, the Exploration and Production program will be refocused on Enhanced Oil Recovery (EOR) and CO<sub>2</sub> injection technologies. The oil remaining after conventional production (377 billion barrels) cannot be recovered without the application of EOR technologies. Carbon dioxide flooding is a proven EOR technology that prolongs the life of some mature oilfields and can potentially contribute to long-term climate change goals.

Reservoirs will be identified based upon economics, technological issues, and feasibility for benefit from CO<sub>2</sub> (currently a waste stream) injection. Technology to make CO<sub>2</sub> flooding applicable to a wider class of reservoirs will be pursued. Oil reservoirs will be mapped with locations of existing power plants and the price and/or incentives for CO<sub>2</sub> that would be needed to make the project economical. Flooding scenarios will be considered to leave maximum CO<sub>2</sub> in the reservoir. Program success will offer options for future carbon management policy choices. *Participants to be determined.*

There was no activity in FY 2003 and FY 2002.

(dollars in thousands)

FY 2002	FY 2003	FY 2004
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- **Advanced Drilling, Completion and Stimulation** . . . . . 2,500 1,500 0

No funding is requested for this activity in FY 2004.

FY 2003 and FY 2002 funding continued upgrades to the Advanced Cuttings Transport Facility that allowed high-temperature/high-pressure experimentation on energized fluids (air, mist, gas assisted, foam, etc.) and synthetic drill fluids, cements, and transport of fluids in horizontal and inclined wellbores. *Participants included: PRRC, University of Tulsa, National Labs, NETL.*

- **Advanced Diagnostics and Imaging Systems** . . . . . 6,284 4,500 0

No funding is requested for this activity in FY 2004.

FY 2003 and FY 2002 funding continued development of advanced reservoir diagnostics and imaging systems to optimize oil discovery and recovery. Developed quantitative engineering parameters that control rock-fluid interactions which impact oil production. Continued fundamental geoscience efforts focusing on geoscience/engineering reservoir characterization on naturally fractured reservoirs. *Participants included: Cal Tech, National Labs, NAS, ERCH.*

- **Multi-National Laboratory/Industry Partnership and National Laboratory Supporting Research** . . . . . 5,850 0 0

No funding is requested for this activity in FY 2004.

No funding was requested in FY 2003. FY 2002 funding continued the transfer of technologies that advance understanding of the characteristics and producibility from oil reservoirs. *Participants included: National Labs*

- **Reservoir Efficiency Processes** . . . . . 7,627 4,236 0

No funding is requested for this activity in FY 2004.

FY 2003 and FY 2002 funding continued development of improved gas flooding recovery methods and advanced the state-of-the-art in reservoir simulation. *Participants included: NETL, TBD.*

- **Analysis and Planning** . . . . . 3,080 2,500 0

No funding is requested for this activity in FY 2004. Appropriate planning and analysis activities will be undertaken in the relevant program areas.

FY 2003 and FY 2002 funding continued technical planning and analysis support for implementing and evaluating effective and efficient oil technology research programs. Enhanced and maintained statistical data, models and supporting systems to evaluate petroleum policy options and to enhance metrics capabilities. Validated the effectiveness of the oil technologies to meet programmatic and agency goals. *Participants included: RMC, IOGCC, TRW.*

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
■ <b>Fundamental Research - PRIME</b> .....	3,900	3,500	0
No funding is requested for this activity in FY 2004.			
FY 2003 and FY 2002 funding continued development of PRIME continued pre-application research focused on the development of exploration and production technologies. General areas include remote sensing/ geochemical survey and improved resolution of 3-component seismic, slimhole tools for logging and testing, remote wireless monitoring and control tools, and advanced petroleum recovery technologies. <i>Participants to be determined</i>			
■ <b>Arctic Research</b> .....	3,642	0	0
No activity in FY 2004.			
No funding was requested in FY 2003. FY 2002 funding continued peer reviewed and coordinated research conducted through Fossil Energy and Energy Efficiency. Also perform outreach and serve as a liaison between the State and DOE. <i>Participants to be determined</i>			
■ <b>Program Support</b> .....	324	164	20
Fund technical and program management support.			
<b>Reservoir Life Extension/Management</b> .....	<b>12,611</b>	<b>9,500</b>	<b>5,000</b>

In FY 2004, the Reservoir Life Extension/Management program will be refocused on Domestic Resource Conservation which will target partnerships with industry and academia to foster cost effective technologies and encourage best practices and approaches to conserve reservoir access to marginal well fields that make up 40% of our domestic production. The goal is to optimize Federal efforts to maintain U.S. domestic oil production capacity and enhance access to the remaining oil resource target.

In previous years, Reservoir Life Extension/Management focused on shorter-term research with a much clearer commercial payoff to industrial participants. Given the industry's incentive to continue this type of research on its own, Federal funding was redirected to longer-term, higher risk efforts that can help preserve U.S. academic and technological leadership in this area.

■ <b>Domestic Resource Conservation</b> .....	12,482	9,405	4,950
In FY 2004, elements include: 1) Key technology prototype development, such as micro-hole technologies, for enabling improved access and minimizing environmental impact; 2) Technology transfer with special emphasis on independents; and, 3) Policy analysis and planning to prioritize program efforts and provide policy evaluations to maximize impact on domestic oil recovery over a wide range of technological and economical conditions. <i>Participants to be determined.</i>			

FY 2003 and FY 2002 funding continued analysis of past projects to capture their benefits. Selected competitive projects that partner with independents to accelerate field testing and use of

effective technologies. Addressed critically underdeveloped resources owned and managed by Native American Tribes and Corporations. Disseminated petroleum RD&D results to domestic stakeholders. Developed mechanisms that foster communication between industry and researchers. Continued to expedite the use of cost effective, more efficient, environmental friendly technologies that increase recovery. Continued support of Minority Education Initiative; continued to provide other energy related educational opportunities. Populated the Internet-accessible database of “best practices” resulting from the PUMP projects and conferences. Solicitation for “PUMP” projects to address short-term demonstrations of critical technologies in specific regions. *Participants included: INEEL, Penn State, HQ, APTA, CEED, COMET, GWPC, U. of Ok, PTTC, RMC, NETL, other National Labs, TBD.*

	(dollars in thousands)		
	FY 2002	FY 2003	FY 2004
■ <b>Program Support</b> .....	129	95	50
Fund technical and program management support.			
<b>Effective Environmental Protection</b> .....	<b>10,426</b>	<b>9,500</b>	<b>8,000</b>

The Effective Environmental Protection program will continue the Environmental Science subprogram which focuses on technologies and practices that reduce the environmental impact of oil exploration, production, and processing while minimizing the cost of effective environmental protection and compliance. The program supports the President’s Clear Skies Initiative by reducing emissions from all aspects of oil production and processing. The program supports energy security by helping to overcome the environmental barriers that limit access to domestic resources. The program supports the recommendations of the National Energy Policy by encouraging additional recovery from existing wells, providing science and technology to allow additional oil development on Federal lands and providing answers to environmental questions that are limiting oil exploration and production in the National Petroleum Reserve - Alaska. The overall objective is to help balance the need to develop the Nation’s energy resources while maintaining our environmental values. It fills critical information and technical gaps that are needed to produce and process the Nation’s energy needs without sacrificing environmental quality.

■ <b>Environmental Science</b>	0	0	7,920
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In FY 2004, conduct targeted initiatives to define and solve specific problems in key focus areas, specifically: 1) management of produced water and use of produced water as a resource for beneficial uses; and, 2) ensuring maximum sustainable access to oil and gas resources on Federal lands. An outreach program will be conducted to ensure that accurate information about the impacts of oil and gas development is presented to the public. Develop objective, credible scientific data for regulatory decisions as part of a program-wide environmental strategy for maintaining U.S. oil production capacity. *Participants include: NETL, National Labs, BLM, TBD*

FY 2003 and FY 2002 funding was included in the activities below.

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
■ <b>Program Planning and Data Analysis</b> . . . . .	823	900	0
In FY 2004, activity combined in Environmental Science activity above.			
FY 2003 and FY 2002 funding continued analysis of industry environmental trends and available technologies. Maintained performance measurement data for program planning and technology transfer. Provided energy and economic analyses for legislative and regulatory initiatives related to oil environmental issues. Provided analysis of refinery related environmental issues and regulations. <i>Participants included: PERF, National Labs, EPA</i>			
■ <b>Streamline State/Tribal/Federal Regulations</b> . . . .	1,515	2,705	0
In FY 2004, activity combined in Environmental Science activity above			
FY 2003 and FY 2002 funding continued development of streamlined, in cooperation with Federal and State agencies, environmental regulations and regulatory processes with emphasis on reducing permitting times for refinery upgrades and domestic production from public lands, while maintaining environmental protection. The objective of this key activity was to increase domestic production and refinery capacity by reducing the cost of compliance. <i>Participants included: ORNL and other National Labs, University of Tulsa, IOGCC.</i>			
■ <b>Risk Assessment</b> . . . . .	3,618	1,800	0
In FY 2004, activity combined in Environmental Science activity above.			
FY 2003 and FY 2002 funding continued development of credible scientific data for regulatory decision making in all aspects of exploration, production, and processing. <i>Participants included: National Laboratories, BLM, PERF, GWPC</i>			
■ <b>Technology Development</b> . . . . .	4,363	4,000	0
In FY 2004, activity combined in Environmental Science activity above.			
FY 2003 and FY 2002 funding continued development of technologies to reduce produced water handling costs and explored innovative refinery technologies that could significantly reduce CO <sub>2</sub> emissions. <i>Participants included: NETL and other National Laboratories, University of Tulsa, GEER.</i>			
■ <b>Program Support</b> . . . . .	107	95	80
Fund technical and program management support.			
<b>Total, Oil Technology</b> . . . . .	<b>56,244</b>	<b>35,400</b>	<b>15,000</b>

## Explanation of Funding Changes

FY 2004 vs. FY 2003 (\$000)
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### Exploration and Production

■ Decreases consist of termination of work in Advanced Drilling, Completion and Stimulation, Advanced Diagnostics and Imaging Systems, Partnership Program, PRIME, Advanced Technologies for High Risk Resources; and Arctic Research. Planning and Analysis is reduced because the program is being realigned to specifically support the President's climate change and energy security goals . . . .	-14,256
■ Program Support . . . . .	-144

### Reservoir Life Extension/Management

■ Decreases consist of termination of work in Technology Development with Independents, Native American Program, Field Demonstrations, and PUMP. Outreach & Technology Transfer is reduced because the program is being realigned to specifically support the President's climate change and energy security goals . . .	-4,455
■ Program Support . . . . .	-45

### Effective Environmental Protection

■ Decreases consist of termination of research on processing heavy crudes and improving refinery processes; research on lower priority environmental issues, such as remediation, NORM, air emissions, and work with the Natural Gas and Oil Technology Partnership . . . . .	-1,485
■ Program Support . . . . .	-15

<b>Total Funding Change . . . . .</b>	<b>-20,400</b>
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